PATENT

SEALED TERMINATING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a terminating device for use in a communications network to interconnect service provider wiring with subscriber wiring. More specifically, the invention relates to a terminating device that is sealed to protect the wiring connections from a flood condition.

2. Background of the Invention

A communications service provider, such as a telephone company, may offer both voice and data transmission services over a communications network. Customers of the service provider, commonly referred to as "subscribers," may purchase as many communications services as they desire and equip their homes, businesses, or the like with equipment to utilize such services. Subscribers are responsible for proper operation of the equipment and the service provider is responsible for proper operation of the communications network up to the interface, commonly referred to as the "demarcation point," between the service provider wiring and the subscriber wiring. The demarcation point is accessible to both the subscriber and the service provider and is typically located at a subscriber site in a network interface device (NID) or a building entrance terminal (BET) that is mounted on the exterior wall of an office, apartment, commercial, or residential building, a home, or the like.

As shown in **FIG. 1**, a NID **12** may be mounted on an exterior wall at a subscriber site **10**. Both service provider wiring **14** and subscriber wiring **16** enter the NID **12**. At least one terminating device for interconnecting the service provider wiring **14** with the subscriber wiring **16** is housed within the NID **12**. The NID **12** may also include at least one protection element for protecting the subscriber's equipment from voltage or current surges carried over the communications network. When the protection element is configured within the NID **12** separate from the terminating device, the terminating device is commonly referred to as a line module. When the protection element is configured within the NID **12** in conjunction with the terminating device, the terminating device is commonly referred to as a protected terminating device (PTD). As used herein, "terminating device" is intended to include any type of apparatus or device for interconnecting service provider wiring with subscriber wiring, configured with or without a protection element, including but not limited to a line module, a PTD, or the like.

Unprotected terminating devices may fail when subjected to a voltage or current surge. When a terminating device fails, the subscriber is no longer able to access the communications network. Further, the service provider must dispatch a technician to the subscriber site to repair or replace the terminating device at significant expense to the service provider. A terminating device may also fail when exposed to moisture for an extended period of time. For example, as illustrated in **FIG. 1**, the NID **12** may be partially or completely submerged under water **18** during a flood condition. The NID **12**, however, is typically not watertight because it must be provided with openings to allow for entry of the service provider wiring **14** and the subscriber wiring **16**. As a result, the terminating device housed within the NID **12** may also be partially or completely submerged during the flood condition. Thus, a need exists for a terminating device than can withstand extended periods of submersion in water and yet still remain functional.

SUMMARY OF THE INVENTION

The present invention relates to a sealed terminating device for interconnecting service provider wiring with subscriber wiring that remains functional following an extended period of submersion in water, such as during a flood condition.

In one embodiment, the invention is a terminating device including a base, a customer bridge attached to the base, and a stuffer assembly mounted to the base. The customer bridge houses at least one insulation displacement contact and has at least one wire insertion hole formed therein for electrically connecting the subscriber wiring to the terminating device. The stuffer assembly has at least one insulation displacement contact for electrically connecting the service provider wiring to the terminating device.

In another embodiment, the invention is a terminating device including a base, a customer bridge attached to the base, and a cover attached to the customer bridge. The customer bridge houses at least one insulation displacement contact and has at least one wire insertion hole formed therein for electrically connecting the subscriber wiring to the terminating device. The cover is movable between a closed position and an opened position and includes a locking slide having a movable clasp.

In yet another embodiment, the invention is a device for terminating service provider wiring and subscriber wiring. The device includes a base, a stuffer assembly mounted to the base, a customer bridge attached to the base, and a cover attached to the customer bridge that is movable between a closed position and an opened position. The stuffer assembly has at least one insulation displacement contact for terminating the service provider wiring to the device. The customer bridge houses at least one insulation displacement contact and has at

least one wire insertion hole formed therein for terminating the subscriber wiring to the device.

In yet another embodiment the invention is a NID for use in a communications network. The NID includes a line module for interconnecting service provider wiring with subscriber wiring. The line module includes a base, a stuffer assembly mounted to the base, a customer bridge attached to the base, and a cover attached to the customer bridge for movement between an opened position and a closed position. The stuffer assembly includes at least one insulation displacement contact for terminating the service provider wiring. At least one insulation displacement contact is housed within the customer bridge for terminating the subscriber wiring.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate one or more embodiments of the invention described more fully below and together with the following detailed description, serve to further explain the invention. In the drawings:

FIG. 1 is an environmental view of a prior art NID mounted on the exterior wall of an office, apartment, commercial, or residential building, a home, or the like;

FIG. 2 is a perspective view of a terminating device according to the invention shown with the cover in the opened position and the stuffer assembly exploded for purposes of clarity;

FIG. 3 is a bottom end view of a NID having the terminating device of **FIG. 2** housed therein and shown with the outer cover of the NID removed for purposes of clarity;

FIG. 4 is an enlarged perspective view of the interior of the NID of **FIG. 3** illustrating the subscriber lock for deterring unauthorized access to the terminating device;

FIG. 5 is an enlarged detail view taken from **FIG. 3** illustrating the closed and locked position of the cover of the terminating device and the inner cover of the NID;

FIG. 6A illustrates the position of the cover of the terminating device relative to the inner cover of the NID with the subscriber lock in place;

FIG. 6B illustrates the steps required for the service provider to open the cover of the terminating device with the subscriber lock in place;

FIG. 6C illustrates the steps required for the subscriber to open the cover of the terminating device with the inner cover of the NID locked and the subscriber lock removed;

FIG. 7 is a top view of the terminating device;

FIG. 8 is an enlarged perspective view of the locking slide of the terminating device;

FIG. 9 is a perspective view of the removable cover of the terminating device;

FIG. 10 is an end view of the terminating device shown with the stuffer in the extended, or disconnected, position for receiving the service provider wiring in the wire insertion passages;

FIG. 11 is an end view of the terminating device shown with the stuffer in the retracted, or connected, position for electrically connecting the service provider wiring with the terminating device; and

FIG. 12 is a perspective view of the base of the terminating device shown with the cover, the customer bridge, and the stuffer assembly removed for purposes of clarity.

DETAILED DESCRIPTION OF THE INVENTION

The invention relates to a terminating device for interconnecting service provider wiring **14** with subscriber wiring **16** (**FIG. 1**). A terminating device **100** constructed in accordance with the invention is shown in **FIG. 2**. The terminating device **100** may be any apparatus or device for interconnecting service provider wiring **14** with subscriber wiring **16**, such as a line module, PTD, or the like. For purposes of example only and not for limitation, the terminating device shown and described herein is a line module **100** that is housed within a NID **12** (**FIG. 3**) to serve as a demarcation point between the service provider wiring **14** and the subscriber wiring **16** in a telecommunications network. The line module **100** includes a base **102** and a customer bridge **104** mounted on the base. The base **102** is positioned over and attached to a generally hollow electronics module **103** that may contain electronic circuitry, such as a printed circuit board or a telephone half-ringer. In another embodiment, the electronics module **103** may contain a protection element, such as a gas tube, varistor, or the like, for protecting the subscriber's equipment from a voltage or current surge carried by the communications network. The electronics module **103** may contain the protection element in place of or in addition to the electronic circuitry. In either instance, the terminating device including the protection element is commonly referred to as a PTD, a protection device, or a protector.

The customer bridge **104** includes a cover **106** that is movable between a first, opened position, shown in **FIG. 2**, and a second, closed position. The cover **106** is provided with a plug **118** that engages a jack **120** formed on the upper surface of the base **102** when the cover is in the closed position. The jack **120** has test contacts disposed thereon that engage the contacts of an RJ-11 plug of a conventional telephone handset in a known manner to test for

the presence of a telephone "dial tone" on the communications network. Since the NID **12** is typically mounted on an exterior wall of an office, apartment, commercial, or residential building, a home, or the like, the line module **100** is susceptible to access by individuals that are not authorized to utilize the telephone service. As will be described in greater detail hereinafter, the terminating device of the invention deters the theft of telephone service by unauthorized individuals and protects the communications network and the subscriber's equipment from damage caused by excessive moisture, such as a flood condition.

The customer bridge **104** houses at least one insulation displacement contact (not shown) and a corresponding actuating arm **122** for electrically connecting the subscriber wiring to the insulation displacement contact, and thus, to the terminating device. In operation, the actuating arm **122** is placed in the "disconnect" position (**FIG. 7**) and the subscriber wiring (not shown) is inserted into the wire insertion hole **124** of the corresponding insulation displacement contact. The actuating arm **122** is then moved from the "disconnect" position to the "connect" position (**FIG. 7**) to force the subscriber wiring into engagement with the insulation displacement contact and thereby electrically connect the subscriber wiring to the customer bridge **104** of the line module **100**. Although the operation of only a single actuating arm **122**, insulation displacement contact and wire insertion hole **124** has been described herein, the customer bridge **104** may be provided with any number of wire insertion holes **124**, insulation displacement contacts and corresponding actuating arms **122**. As shown herein, the customer bridge **104** has a plurality, and more specifically four, pairs of wire insertion holes **124** and insulation displacement contacts, each pair corresponding to one of the four actuating arms **122**. Accordingly, the customer bridge **104** may accommodate, for example, up to four twisted pair tip and ring wires from various subscriber telephone

equipment. As one of ordinary skill in the art will readily understand and appreciate, two or more conductive members (not shown) are provided to electrically connect the insulation displacement contacts housed within the customer bridge **104** to corresponding subscriber tip and ring conductors disposed within the jack **120** formed in the base **102**.

The base **102** is similarly provided with at least one insulation displacement contact **116** and a stuffer assembly **109** for electrically connecting the service provider wiring to the line module **100**. As is well known, each insulation displacement contact **116** has a pair of opposed, sharp edges for piercing any insulation that may be present on the service provider wiring. The stuffer assembly **109**, shown exploded in **FIG. 2**, includes a conventional stuffer **108** and stuffer screw **112** that cooperate to force the service provider wiring (not shown) into engagement with the insulation displacement contact **116**, as will be described. The stuffer **108** is positioned for vertical movement on a post **114** that is internally threaded for receiving the externally threaded stuffer screw **112**. The stuffer **108** further has a test port **111** formed therein for receiving a test clip to verify the integrity of the electrical connection between the service provider wiring and the insulation displacement contact **116**.

In operation, the service provider wiring is inserted into horizontally disposed wire insertion passages **126** formed in the stuffer **108** and though an opening **115** formed in the upper portion of the insulation displacement contact **116**. The external threads of the stuffer screw **112** engage the internal threads of the post **114** to drive the stuffer **108** downwardly against the service provider wiring positioned in the opening **115**. As a result, the service provider wiring is brought into engagement with the opposed, sharp edges of the insulation displacement contact **116**, thereby piercing any insulation surrounding the service provider wiring and electrically connecting the service provider wiring to the line module **100**. As one

of ordinary skill in the art will readily understand and appreciate, two conductive members (not shown) are provided to electrically connect the insulation displacement contacts **116** to corresponding service provider tip and ring conductors disposed within the jack **120** formed in the base **102**. Accordingly, the insulation displacement contacts housed within the customer bridge **104** may be electrically connected to the insulation displacement contacts **116** by engaging the subscriber conductors and service provider conductors disposed in the jack **120**, and thereby selectively interconnect the service provider wiring with the subscriber wiring.

The cover **106** is equipped with a locking slide **110** that incorporates a movable clasp **128**. The clasp **128** (**FIG. 8**) has a concave leading edge for cooperating with a subscriber lock **30** (**FIG. 3**). **FIGS. 3-5** illustrate the interaction between the inner cover **20** of a conventional NID **12** and the line module **100**, and more specifically, the interaction between the inner cover **20** of the NID **12**, the movable clasp **128** of the line module **100**, and the subscriber lock **30**. The subscriber lock **30** deters unauthorized access to the line module **100**, while permitting the subscriber and a craftsperson from the service provider to open the cover **106** of the line module **100** to access the actuating arms **122** that connect and disconnect the subscriber wiring with the insulation displacement contacts housed within the customer bridge **104**. The craftsperson must still be able to open the cover **106** of the line module **100** for purposes of testing the electrical connections between the subscriber wiring and the customer bridge **104** even if dispatched when the subscriber is not at the customer site. As best shown in **FIG. 5**, the lip **22** of the inner cover **20** overlies and closely abuts the clasp **128**. The lip **22** prevents substantial lateral movement of the clasp **128**. However, once the inner cover **20** is opened, the lip **22** no longer overlies and closely abuts the clasp **128**. Accordingly, the cover

106 may be opened with the locking arm **32** of the subscriber lock **30** captured within the clasp **128**.

The interaction between the lip **22** of the inner cover **20** of the NID **12**, the clasp **128** and the cover **106** of the line module **100** is illustrated in **FIGS. 6A, 6B,** and **6C**. As discussed above, the locking arm **32** of a subscriber lock **30** may be captured within the clasp **128**. The clasp **128** may then be positioned as shown in **FIG. 6A**. In this position, the cover **106** cannot be opened because the clasp **128** has a lower portion **128B** that is captured beneath the lip **22**. In a NID **12** servicing multiple subscribers at the same site, such as an apartment or commercial building, an unauthorized person may attempt to open the cover **106** of the line module **100** to steal communications service. Once the cover **106** of the line module **100** is opened, the unauthorized person can insert the RJ-11 plug of a conventional telephone handset into the jack **120** formed in the base **102** and utilize the communications service. The subscriber lock **30** deters unauthorized use of the communications service. In the event that an unauthorized person forces open the cover **106** of the line module **100**, the lower portion **128B** of the clasp **128** will be broken off. The damage to the lower portion **128B** of the clasp **128** provides a visual indication that an unauthorized person has attempted to gain access to the customer bridge **104** of the line module **100**.

If a craftsperson dispatched by the service provider needs to gain access to the customer bridge **104** of the line module **100**, he will be able to open the inner cover **20** using a special tool that is typically available only to authorized personnel. As shown in **FIG. 6B**, opening the inner cover **20** removes the lip **22** from a position overlying the clasp **128**. The cover **106** of the line module **100** can then be opened because the clasp **128** and the locking arm **32** of the subscriber lock **30** are affixed to and move with the cover **106**. Alternatively,

the subscriber or a person authorized by the subscriber can remove the subscriber lock **30**, as shown in **FIG. 6C**, and the cover **106** can be opened with the inner cover **20** of the NID **12** locked and the lip **22** in place.

FIG. 7 provides a top view of the line module **100**. A hinge **134** provided on the customer bridge **104** cooperates with hinge arms **135** provided on the cover **106** to hingedly attach the cover to the customer bridge. The stuffer **108** of the stuffer assembly **109** is shown to the immediate left of the locking slide **110** and the movable clasp **128**. The stuffer **108** must move from an extended, or disconnected, position to a retracted, or connected, position to engage the service provider wiring with the insulation displacement contacts **116**. In the disconnected position, the stuffer **108** must not interfere with the clasp **128** or the lip **22** of the inner cover **20** (see **FIG. 6A**). As previously described, the stuffer screw **112** is used to move the stuffer **108** between the disconnected and the connected positions. The lip **22** of the inner cover **20** rests slightly above the stuffer **108**. The stuffer **108** may have an angled surface to permit a craftsperson dispatched by the service provider to insert the service provider wiring into the wire insertion passages **126**. The actuating arms **122** can easily be accessed and moved between the disconnected position and the connected position (as shown). Slots **132** are formed through the cover **106** to receive the actuating arms **122** and thereby provide a visual indication of the status of the subscriber wiring. As previously described, four actuating arms **122** are shown. However, this is merely an embodiment of the present invention and is not intended to limit or prescribe the number or location of wire insertion holes **124** (not shown), actuating arms **122**, or insulation displacement contacts (not shown) housed within the customer bridge **104** of the line module **100**.

FIG. 8 is a more detailed perspective view of the movable clasp **128** and **FIG. 9** is a more detailed perspective view of the removable cover **106**. As discussed above, the clasp **128** is slidably captured within the locking slide **110**. The locking slide **110** is preferably integrally formed with the cover **106**. The clasp **128** has an upper surface **128A** that is shaped and dimensioned to engage a user's fingertip. As previously described, the clasp **128** also has a lower portion **128B** that is generally planar and relatively thin. The lower portion **128B** is relatively thin so as to fit comfortably between the lip **22** of the inner cover **20** and the stuffer **108** of the stuffer assembly **109** within the NID **12**. The shape of the lower portion **128B** provides sufficient surface area to ensure adequate contact with lip **22** of inner cover **20**. Further, the attachment point between the lower portion **128B** and the rest of the clasp **128** is sufficiently small such that the lower portion **128B** will snap off if an unauthorized person attempts to gain access to the line module **100** by forcing open the cover **106**. Damage to the lower portion **128B** of the clasp **128** provides a visual indication that an unauthorized person has attempted to gain access to the line module **100**. The clasp **128** also has an opening **128C** for receiving the locking arm **32** of the subscriber lock **30** or a similar locking device to permit the subscriber to limit access to the line module **100** to authorized persons.

The stuffer **108** of the stuffer assembly **109** is better shown in **FIGS. 10 and 11**. The stuffer **108** forces service provider twisted pair tip and ring wires inserted into wire insertion passages **126** between the opposed, sharp edges of the insulation displacement contacts **116**, piercing any insulation on the service provider wiring, and thereby electrically connecting the service provider wiring to the line module **100**. Openings **115** in the upper portion of the insulation displacement contacts **116** generally align with the wire insertion passages **126** when the stuffer **108** is in the disconnected position. The service provider wiring is advanced

into the wire insertion passages **126** so that the ends of the wiring extend through the openings **115** in the insulation displacement contacts **116**. The stuffer screw **112** is then rotated clockwise to drive the stuffer **108** downward to the connected position shown in **FIG. 11**. The service provider wiring is forced between the opposed, sharp edges of the insulation displacement contacts **116**. The sharp edges cut through any insulation on the service provider wiring and contact the conductive wires to establish an electrical connection between the service provider wiring and the line module **100**.

The base **102** of the line module **100** is shown in **FIG. 12** with the cover **106** and the stuffer assembly **109** removed for purposes of clarity. The base **102** includes an internally threaded post **114** for receiving the stuffer screw **112**. The base **102** further has slots **140** formed therein for receiving and retaining the insulation displacement contacts **116**. As previously described, the base **102** includes a jack **120** for accepting a conventional RJ-11 test plug. The jack **120** provides a demarcation point to determine whether a fault exists in the service provider wiring or equipment or in the subscriber wiring or equipment. For example, if a telephone dial tone is detectable at the jack **120** and yet the subscriber does not have telephone service, then the problem is downstream from the jack **120** in the subscriber wiring or equipment. However, the jack **120** can short or otherwise fail if exposed to excessive moisture. Therefore, the jack **120** is provided with a first seal **142** that mates with a second seal **144** (shown in **FIG. 2**) provided on the underside of cover **106**. The first seal **142** and the second seal **144** have complementary surfaces that produce a watertight seal, and thereby prevent moisture from entering the jack **120**, for example, if the line module **100** is submerged in a flood condition. The plug **118** floats on the cover **106** due to the resiliency of the second seal **144**. Similarly, the plug **118** may float within the jack **120** due to the resiliency of the fist

seal **142**. Accordingly, the first seal **142** and the second seal **144** naturally align when the plug **118** is inserted into the jack **120**. As a result, the manufacturing tolerance required for the distance between the hinge arms **145** and the plug **118** may be increased, thereby reducing manufacturing cost. In other words, the plug **118** does not have to be rigidly affixed to the underside of the cover **106**. Thus, the plug **118** can shift slightly to ensure a secure, watertight seal when the plug **118** enters the jack **120**.

It should be noted that the line module **100** shown and described herein utilizes insulation displacement contacts to terminate both the service provider wiring and the subscriber wiring. As a result, the electrical connections can be effectively sealed from the deleterious effects of vibration, shock, and in particular, moisture, in a known manner using a commercially available grease or gel sealant. Furthermore, the telescoping action of the floating plug **118** effectively seals the test contacts located within the jack **120** when the plug is inserted into the jack. Accordingly, the entire line module **100** may be sealed against exposure to excessive moisture, such as may occur if the line module is submerged in a flood condition. In addition, the use of stuffer **108** and removable cover **106** having locking slide **110** and movable clasp **128** permits a subscriber to deter unauthorized access to the customer bridge **104** of the line module **100**, while at the same time permitting a craftsperson dispatched by the service provider access to the customer bridge **104**. The clasp **128** also provides a visual indication that an unauthorized person has attempted to gain access to the jack **120** provided on the customer bridge **104** of the line module **100**.

While the invention has been shown in only one of its forms, it should be apparent to those skilled in the art that it is not so limited, but is susceptible to various changes without departing from the scope of invention. Accordingly, it is intended that the appended claims

encompass any alternative embodiments of the invention not disclosed herein that are within the ordinary skill of a person knowledgeable in the art of terminating devices.